EXHIBIT I

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF WEST VIRGINIA
CHARLESTON DIVISION

IN RE: BOSTON SCIENTIFIC CORP., PELVIC REPAIR SYSTEM PRODUCTS LIABILITY LITIGATION — **MDL NO. 2326**

This document relates to:

ALL WAVE 1 AND 2 CASES IN MDL NO. 2326

RULE 26 EXPERT REPORT OF SCOTT GUELCHER, Ph.D.

The following report is provided pursuant to Rule 26 of the Federal Rules of Civil Procedure. The opinions which are held and expressed are as follows:

I. QUALIFICATIONS

I received my Bachelor's Degree in Chemical Engineering from Virginia Tech in 1992, my Master's Degree in Chemical Engineering from the University of Pittsburgh in 1996, and my Ph.D. in Chemical Engineering from Carnegie Mellon University in 1999. I completed my training as a Post-Doctoral Research Associate in Biomedical Engineering at Carnegie Mellon University in 2005.

I have been an Associate Professor in the Department of Chemical and Biomolecular Engineering at Vanderbilt University since 2012, and prior to that I was an Assistant Professor in that department from 2005 through 2012. I have taught many courses at Vanderbilt, including Chemical Reaction Engineering, Polymer Science and Engineering, Bioprocessing Engineering, Introduction to Engineering, Molecular and Cell Biology for Engineers, and Product and Process Design.

My professional experience includes: Senior Associate Scientist at Bayer Corporation, Polyurethanes Division, in South Charleston, West Virginia from 2002-2003; Associate Scientist at Bayer Corporation, Polyurethanes Division from 1999-2001; Trainee at Philips Research, in Eindhoven, The Netherlands in 1998; Limited Service Employee at Eastman Chemical Co. from 1995-1997; and Chemical Engineer at Eastman Chemical Co. from 1992-1994.

I a co-editor of the book, *An Introduction to Biomaterials*, SA Guelcher and JO Hollinger, eds., Boca Raton: CRC Press 2006. I am also the author of several book chapters, including, but not limited to, SA Guelcher, Polyurethanes. In *An Introduction to Biomaterials*, 161 – 183. SA Guelcher and JO Hollinger, eds. Boca Raton, CRC Press 2006; SA Guelcher and JO Hollinger, Introduction. In *An Introduction to Biomaterials*, 1 – 2. SA Guelcher and JO Hollinger, eds. Boca Raton, CRC Press 2006; and SA Guelcher, Biocompatibility of Injectable Materials. In *Injectable Biomaterials: Science and Applications*. B Vernon, ed. Woodhead Publishing 2011; and EM Prieto and SA Guelcher, Tailoring Properties of Polymeric Biomedical Foams. *In Biomedical Foams for Tissue Engineering Applications*. P Netti, ed. Woodhead Publishing 2014. My areas of research include biomaterials design and development, drug and gene delivery, tissue engineering, and *in vitro* models for cancer metastasis.

system was reported to duplicate ESC of poly(ether urethane)s *in vivo*.[60] I have published two papers in the scientific journal *Biomaterials*, one in 2011 (cited 33 times) and one in 2014 (cited 3 times), using the same 20% H_2O_2 /0.1 M cobalt chloride system to measure the oxidative degradation rate of poly(ester urethane) and poly(thioketal urethane) scaffolds. Thus, this *in vitro* oxidative degradation test is well established in the scientific literature, and was available to Boston Scientific at the time it developed all of the meshes at issue in this report. In the experiment with Dr. Dunn, unstabilized PP pellets (control), Ethicon TVT, BSC Advantage mesh, and BSC Lynx mesh were incubated in the oxidative solution at 37°C for up to 5 weeks. Dr. Dunn performed the experiment in his chemistry laboratory at Vanderbilt University in consultation with me.

The results from the *in vitro* degradation testing are presented in Appendix G (Advantage), Appendix H (Lynx), and Appendix I (unstabilized PP) of Dr. Dunn's expert report. I have reviewed these data and drawn several conclusions. First, the FTIR spectra for unstabilized PP pellets reveal substantial increases in the hydroxyl and carbonyl peaks at week 4. Similarly, the XPS data show a substantial increase in the R-C-OOH peak from week 3 to week 4. These data indicate an induction time of ~4 weeks (28 days) for unstabilized PP under *in vitro* oxidation conditions, compared to 108 days *in vivo* found by Liebert et al. Thus, the *in vitro* test appears to accelerate degradation by a factor of approximately 4. For TVT, Advantage and Lynx meshes used in this experiment, the increase in hydroxyl and carbonyl peak area occurs from week 4 to 5, suggesting a less than 5 week (35 day) induction period in this medium. Assuming that degradation occurs 4 times faster under *in vitro* compared to *in vivo* conditions, as reported by Liebert et al, these data predict an *in vivo* induction time of ~135 days for the PP in the TVT, Advantage and Lynx meshes.

The SEM micrographs in Dr. Dunn's appendices for this experiment also reveal degradation of Advantage and Lynx PP meshes, as shown in Figure 10. Mesh not exposed to *in vitro* oxidizing medium did not show evidence of pitting on the surface. However, mesh exposed to the *in vitro* oxidizing medium for 5 weeks showed evidence of pitting on the surface.

These *in vitro* data are consistent with the opinion exemplified in Figure 4 that antioxidants do not

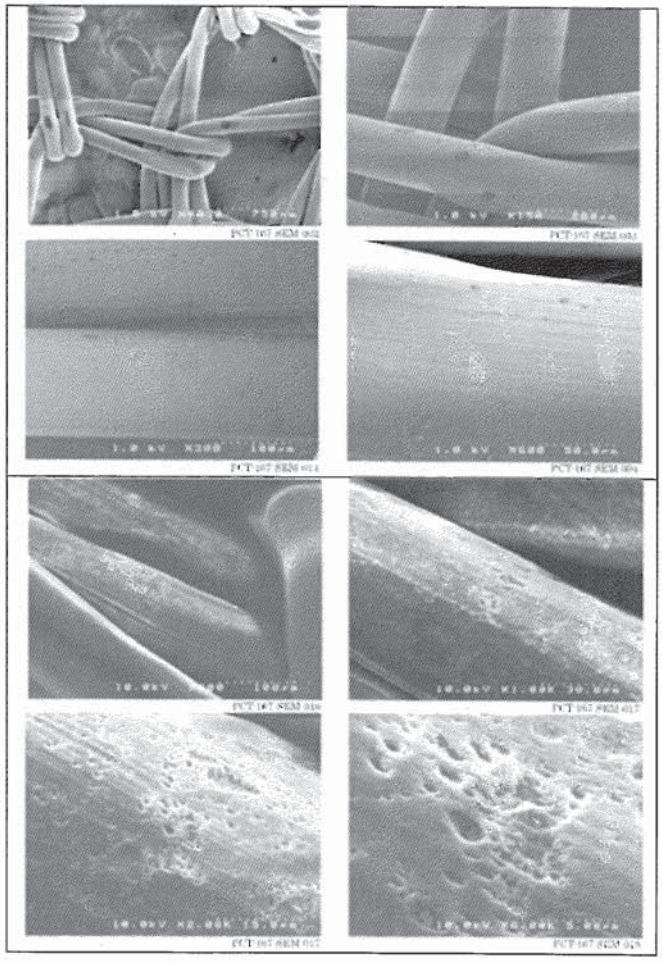

Figure 10. SEM images of Exemplar Advantage Fit Transvaginal Mid-Urethral Sling System. Top 4 panels: Mesh not exposed to *in vitro* oxidizing medium. Bottom 4 panels: Mesh exposed to *in vitro* oxidizing medium for 5

[60] Id.

protect the mesh for an infinite period of time and are eventually depleted. After depletion of the antioxidants, the PP is not protected and will react with ROS, resulting in embrittlement. Importantly, the *in vitro* oxidation test method described herein was available to Boston Scientific at the time that the Advantage and Polyform meshes were developed and could have been used to optimize the antioxidant package and determine the induction time of the PP mesh. However, I have seen no evidence that Boston Scientific performed *in vitro* oxidation testing of its pelvic meshes.

The three requirements for environmental stress cracking are (1) stress on the biomaterial, (2) a source of reactive oxygen, and (3) a biomaterial with a chemical structure rendering it susceptible to oxidation.[61] Applying what is known regarding the intended environment where these meshes are placed, it is apparent that: (1) the forces exerted on the mesh after implantation will vary greatly from patient to patient; (2) the scientific literature has confirmed that adherent macrophages and FBGCs are present on the PP mesh *in vitro*, and that these cells secrete ROS which reacts with the mesh; and (3) the scientific literature and our *in vitro* testing separately confirm that PP degrades by oxidation. Thus, all three requirements are present when PP mesh is implanted in the pelvic floor. This cycle of depletion of antioxidants through reaction with ROS followed by the eventual embrittlement of the surface of the mesh surface will not stop until all of the mesh is removed, since cracking exposes new surfaces to ROS and the reaction begins anew.[62]

8) Plaintiff Specific Opinions

As part of my training and research in biomaterials, I routinely review histopathology including tissue samples and slides containing explanted material and devices. I have the relevant expertise and have published papers with detailed histologic and histomorphometric analyses of scaffolds designed for healing of soft tissue and bone.[63]

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[61] Anderson et al. Cellular interactions with biomaterials: in vivo cracking of pre-stressed Pellethane 2363-80A. JBMR 24: 621-37, 1990.
[62] Anderson Seminar Immunol 2008

[63] *EM Prieto*, *AD Talley*, S, Drapeau, K Kalpakci, SA Guelcher*. Effects of particle size and demineralized bone matrix on remodeling of settable bone grafts in a rabbit femoral condyle defect model. *Journal of Biomedical Materials Research Part B: Applied Biomaterials* In Review; *EJ Adolph*, JM Davidson, SA Guelcher, LB Nanney*. Biodegradable polyurethane scaffolds promote healing in a porcine full-thickness excisional wound model. *Journal of Biomaterials Science: Polymer Edition* DOI:10.1080/09205063.2014.965997 Oct 7, 2014; *AJ Harmata*, CL Ward, *KJ Zienkiewicz*, JC Wenke, SA Guelcher*&. Investigating the Effects of Surface-Initiated Polymerization of ε-Caprolactone to Bioactive Glass Particles on the Mechanical Properties of Settable Polymer/Ceramic Composites. *Journal of Materials Research* 29: 20, 2014; JL Martin, MK Gupta, *JM Page*, F Yu, JM Davidson, SA Guelcher, CL Duvall*. Synthesis of a Porous, Biocompatible Tissue Engineering Scaffold Selectively Degraded by Cell-Generated Reactive Oxygen Species. *Biomaterials* 35(12):3766-76, 2014.; *JE Dumas*, *EM Prieto*, *KJ Zienkiewicz*, T Guda, JC Wenke, JM Bible, GE Holt, SA Guelcher*. Remodeling of Settable Allograft Bone/Polymer Composites with Initial Bone-like Mechanical Properties in Rabbit Femora. *Tissue Engineering Part A* 20(1-2):115-29, 2014; *JM Page*, *EM Prieto*, *JE Dumas*, *KJ Zienkiewicz*, JC Wenke, P Brown-Baer, SA Guelcher*. Reactivity and biocompatibility of injectable polyurethane/allograft bone biocomposites. *Acta Biomaterialia, 8:4405–4416, 2012; JE Dumas*, P Brown-Baer, *EM Prieto*, T Guda, R Hale, JC Wenke, SA Guelcher*&. Injectable reactive biocomposites for bone healing in critical-size rabbit calvarial defects. *Biomedical Materials* 7(2): 024112, 2012; *EJ Adolph, AE Hafeman*, KL Zienkiewicz, JM Davidson, SA Guelcher*. Injectable biodegradable polyurethane scaffolds for wound healing. *Journal of Biomedical Materials*

I have reviewed images of histological sections of explants taken from from Ms. Hembree, Ms. Nava, Ms. Parker, Ms. Robinson, Sharon Beehler, Ms. Hanson, and Lori Hoffman. One group of slides was stained with hematoxylin and eosin (H&E) stain, while the other was stained with primary antibodies to myeloperoxidase and counter-stained with hematoxylin. I have determined that there are adherent macrophages and/or foreign body giant cells near the surface of the polypropylene mesh in all cases. I have also observed positive staining for myeloperoxidase in all 7 patient explants. Staining for myeloperoxidase was most intense near the surface of the PP.

In all instances, the presence of macrophages and/or FBGCs, as well as the evidence of myeloperoxidase, is consistent with what the peer-reviewed literature has reported with respect to the effects of secreted ROS on biomedical implants.[64]

Research Part A 100A: 450–461, 2012. PMC328836; Guelcher SA, Brown KV, *Li B*, Guda T, *Lee BH*, and JC Wenke*[&]. Dual-purpose bone grafts improve healing and reduce infection. *Journal of Orthopaedic Trauma* 25(8):477-82, 201; K Brown, *B Li*, T Guda, DS Perrien, SA Guelcher, JC Wenke*. Improving Improving bone formation in a rat femur segmental defect by controlling BMP-2 release. *Tissue Engineering Part A* 17(13-14): 1735-1746, 2011; *AE Hafeman, KJ Zienkiewicz*, AL Zachman, HJ Sung, LB Nanney, JM Davidson, SA Guelcher*. Characterization of degradation mechanisms of biodegradable lysine-derived aliphatic polyurethanes. *Biomaterials* 32(2):419-29, 2011. PMC29973472; *B Li*, JM Davidson, and SA Guelcher*. The effect of the local delivery of platelet-derived growth factor (PDGF-BB) from reactive two-component polyurethane scaffolds on the healing in rat skin excisional wounds. *Biomaterials* 30:3486–3494, 2009.

[64] Polypropylene as a reinforcement in pelvic surgery is not inert: comparative analysis of 100 explants. Int Urogynecol J (2010) 21:261-270; Anderson et al. Cellular interactions with biomaterials: in vivo cracking of pre-stressed Pellethane 2363-80A. JBMR 24: 621-37, 1990; James M. Anderson1,2,*, Analiz Rodriguez1, and David T. Chang2. Foreign Body Reaction to Biomaterials. Semin Immunol. 2008 April ; 20(2): 86–100;

VI. COMPENSATION

The compensation per hour which I expect to be paid for my review, study and testimony is as follows: $285.00 per hour for review and study, $385.00 per hour for deposition and trial testimony time.

Scott A. Guelcher, Ph.D.